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EQUATION-OF-STATE DATA OF SYNTHETIC URANUS

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New equation-of-state data for the liquid mixture we call synthetic Uranus is discussed. This liquid was double-shocked to 220 GPa and 3 g/cm^3. These data are coincident with the adiabat of Uranus calculated by Hubbard and Marley.

The Voyager II spacecraft provided an abundance of new observational data for Uranus.[1] These data have been used to greatly refine our knowledge of this planet.[2-6] Uranus is composed of an outer H_2-rich region of approximately solar abundance and an inner region composed of the "ices" (H_2O, CH_4, and NH_3), H_2, and rock. Interior pressures and temperatures reach several 100 GPa and several 1000 K. Equation-of-state data are needed for planetary materials at high pressures and temperatures for comparison with theoretical equations of state used to calculate the chemical composition of these planets.

Synthetic Uranus is a representative mixture of water, ammonia, and isopropanol with relative abundances of H, O, C, and N similar to the expected composition of the deep interior of Uranus. Shock compression of liquid specimens achieves pressures and temperatures comparable to those in planetary interiors. Shock-compression data were published previously for synthetic Uranus single-shocked up to 76 GPa.[7] We have now achieved double-shock pressures in the range 98-218 GPa. Double-shock compression to a given density produces temperatures which are substantially lower than achieved by single-shock to the same density. This process permits one to achieve by dynamic compression a range of states close to planetary adiabats.

Our new data for synthetic Uranus are in excellent coincidence with the pressure-density relation in Uranus calculated by Hubbard and Marley.[5] The 3 g/cm^3 we achieved corresponds to a depth of about one-half the radius of Uranus, or about 12,000 km.

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